Confessions of a Laggard in the Post-Digital Age

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Abstract:

EdTech is ever evolving and is ever present in our post-digital age. As technology evolves, there is continued pressure to adapt and develop skills and digital literacies in order to take advantage of the new opportunities. These innovative platforms have been designed to include a range of technical, social and cognitive affordances and signifiers. Yet there are those educators (and even students) that stubbornly refuse, resist or reject new innovations. According to Everett Roger's Diffusion of Innovation curve, these "Laggards" will only adopt new technology when virtually forced to. We might make certain assumptions or judgements about the aptitudes or attitudes of these "Tech-Laggards" in education. We might even write them off as hopeless and beyond help. However, is it the fault of the Laggard or the fault of the engineers? Are the innovators and early adopters entirely blameless? How important is the context? This session will encourage participants to analyse these preconceptions and other potential underlying causes and reasons for Laggard-like behaviour. These will include complementary innovations, differentiation requirements, intended audiences, post-digital misconceptions, and technology development rates.

Interactivity Description:

The format of this general session will be a roundtable discussion where the presenter will share their own analysis of how Google Sheets are used and taught in pre-collegiate science education. A collaborative Miro will be shared to allow participants to engage with the material and questions being raised. Participants will be asked to share ideas on what technologies they see evidence of laggard behaviour, their analysis of the affordances and signifiers of their chosen technologies and their opinions of the underlying causes of Laggard-like behaviour for their chosen technology. Finally, solutions to Laggard-like behaviour will be verbally discussed.

Keywords: Post-Digital, Diffusion of Innovation, EdTech, Digital Literacy, Laggard

Introduction:

Data Science education is becoming an increased focus across the world, with new education standards coming into effect over the last decade in multiple nations such as the United States (NGSS Lead States, 2013) and the European Union (European Commision, 2021). As our world becomes more complex and digitalised, our data does too. Studies have found that the main data source science teachers use in lessons is small, student-collected data sets. To process and analyse this data, they encourage the use of familiar and available digital tools: spreadsheets and calculators. (Rosenberg et al., 2022). Whilst spreadsheets are nothing new, students entering secondary education often start using them for the first time in science lessons. From creating simple tables and graphs to performing complex calculations, each student goes on a journey of skill development with varying levels of success. Spreadsheets such as Google Sheets have a range of cognitive, social and technical affordances and signifiers that can benefit a student-centred learning approach to science education.

Affordances of Google Sheets:

Cognitive Affordances:

- You can transform and process data in any way that helps your analytical process
- You can learn the critical aspects of algebra more effectively

Social Affordances:

- Teachers and students can add comments to cells
- you can insert smart chips to link a contact
- insert a calendar event or document, students can collaborate in real time,
- students can create shareable links with different permissions.
- A related anti-affordance for schools with Google suites is the appearance of warning signs if sharing the sheet with emails outside of your organisation

Technical Affordances:

- Students can automatically re-size cells to fit the text or wrap text within a cell.
- You can calculate perform a range of calculations and duplicate these calculations to other cells by dragging the formula.
- If you update the raw data, the values will automatically recalculate.
- You can apply filters and sort data.
- You can rotate text within a cell.
- You can add slicers to filter only the data you want.
- You can freeze views.
- You can insert charts which will automatically update if the raw data is changed.
- Google Sheets offers suggestions for graph types based on the data provided.
- When repeating ideas come up, Google sheet offers an autocomplete to save time.
- You can apply data validation to provide a drop-down list to choose from.
- A related anti-affordance is an error warning if the data inputted is not valid.

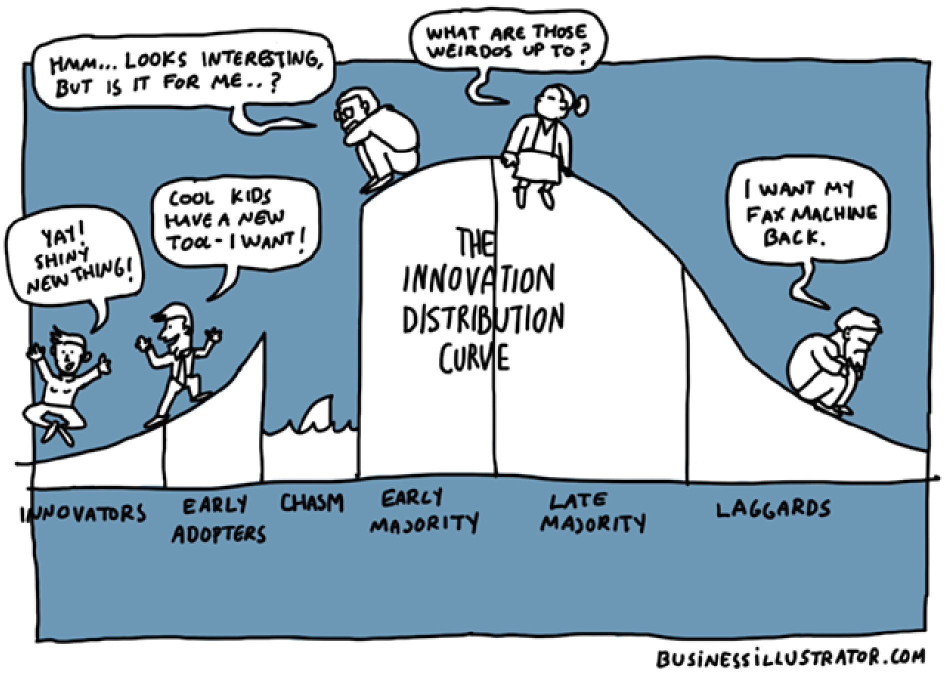
Technical Signifiers:

- When you hover between column/row headings the cursor changes to a hand to suggest dragging and to a double-headed arrow to suggest re-sizing
- cursor changes to a black cross to signify dragging/duplicating data
- Red triangles in cells signify errors in calculations or validation.
- Pop-up descriptors when hovering over images in the ribbon menu

Diffusion of Innovation:

Every science teacher has their own tricks and tools to encourage the uptake of this digital tool, however, some students seem more resistant than ever. If likened to Everett Rogers's Diffusion of Innovation curve, we may be able to recognise some of our student's responses during a data processing lesson using spreadsheets.

Figure 1: *A cartoon depiction of the Diffusion of Innovation curve (including Geoffrey Moore's later addition of the chasm). From Oinonen (2017).*

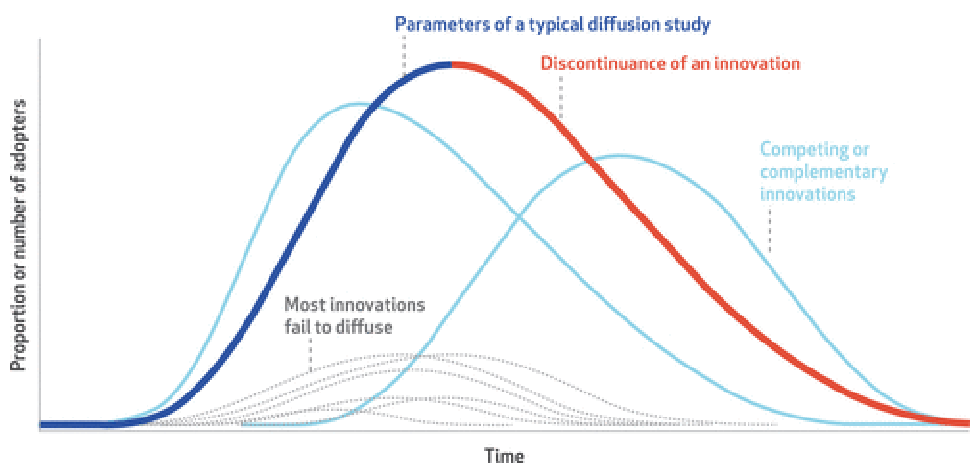


As seen in Figure 1, there may be those in each science class that could be considered innovators. They instantly understand the value added and quickly navigate and explore the tool to learn new skills and tricks. Early adopters follow shortly behind, but then comes the chasm. The author is of the opinion that this chasm is widening and widening. Students seem more and more resistant to learning spreadsheets, despite the technology being around for many years. This paper aims to explore the reasons why this is the case from an educational leadership perspective.

Reason 1: Competing or complementary innovations

As ICT lessons have fallen out of fashion, and graphical display calculators (GDCs) have risen in popularity; science teachers have been the last group to teachers to expect students to use Google Sheets and spreadsheets in general. Yet many science teachers have failed to realise this and are bewildered about why students refuse to use spreadsheets in the way they were designed, and instead preferring to complete all the calculations with their GDCs and typing in the answer. Many assume the fault lies with the "Laggard" student instead of undergoing an analysis of the changing context and rise of competing innovations. Dearing and Cox (2018) identified this as a major factor resulting in a skew of the typical distribution of innovation diffusion (as seen in Figure 2).

Figure 2: *A graph illustrating the relationships between rates of adoption and how we characterize diffusion under different scenarios. From Dearing & Cox (2018).*



DISCUSS: Do you have any experience of technologies that have competing or complementary innovations? Which technology is winning? Why?

Reason 2: the changing design of the technology

When interviewing science teachers regarding their digital literacies and use of EdTech in the classroom, several teachers mentioned the challenge of the rate of technology development. The following two statements exemplify this problem.

> *"Technology develops really, really fast and I don't feel I can keep up to how things are developed."*
> *"Every tool requires a time for learning, for developing minimum proficiencies to advance proficiencies for both the teachers and the students."*

This is particularly relevant for online EdTEch tools that undergo several updates throughout a year, in comparison to the past where updates would come every three to 5 years as you updated your entire operating system. For instance, Microsoft Excel was introduced in 1985 and then updated in 1990, 1995, 1999, 2003, 2007, 2010, 2013, 2019. Even then, updating your software was not compulsory. In the first quote, the teacher acknowledges the speed of development, this is perfectly illustrated by some of the changes in Google Sheets features since Janurary of 2021. These include using range namebox, column stats, slicers, integration with Google meet, filter comments, smart compose, apply a colour theme, data cleanup, data connectors and smartchips. Even as a power user of Google Sheets, I would be hard-pressed to tell you I know what each of these new features does and how to access them. They also updated and reworded almost all parts of the menu bar and introduced new iOS shortcuts. Many of the changes to the menu are in the name improving the design features such as signifiers. According to Google Workspace Updates, they shortened some item descriptions in the menu to allow faster recognition and added icons to help the end user find features more easily ('Enhanced Menus in Google Sheets Improves Findability of Key Features', 2021). However, imagine a reluctant user of Google Sheets; they were just about getting the hang of the basic features of a spreadsheet, only to find that the next time they open the file, it has completely transformed and they don’t know where to find the features they once used regularly without problems. Both the power user and the laggard need time for developing proficiencies when tools change and adapt.

DISCUSS: Do you have any experience of technologies changing rapidly? Who succeeds? Who gets left behind?

Reason 3: the intended audience of the technology

When using Google Sheets in pre-collegiate science classrooms, it struck me that many of the features available are not relevant to the students' needs which one could argue adds unnecessary complexity. The fact of the matter is that pre-collegiate students are not the intended audience of the technology. Whilst the engineers have tried to cram in as many features as possible, they have also aimed to streamline the ease of use by including auto-complete suggestions for calculations and graphs (amongst others). Whilst this may seem like it will make the tool more accessible to pre-collegiate students, Bhargava and D’Ignazio (2015) suggested that digital technology that supports learning how to work with data is not necessarily a tool that maximizes ease of use, but rather one that makes the operations explicit so that learners understand exactly what is being done and why. At the pre-collegiate level, utilising auto-complete might actually hinder the development of skills and understanding.

DISCUSS: Do you have experience of technologies that may be being used by the “wrong” audience? What are the consequences of this in your context?

Reason 4: the level of differentiation required

Science teachers, like all educators, are well aware of best practice regarding differentiation in the classroom regarding content, language literacy and skills. However, one underappreciated area that differentiation is required for is digital literacy. When interviewing science teachers on the challenges of using of EdTech in the classroom, one teacher expressed the following experience that exemplifies the differentiation required:

> *"take spreadsheets for example, maybe their skills are not the same, but we might consider all of them know how to do it, but sometimes some of them can calculate an average into a graph, and some of them don't know how to put the data in one of the cells. So, in terms of differentiation, I think, like the... the use of digital technology can be tricky."*

Skill development moves along a spectrum from emerging (can copy others), to developing (can do with support), to secure (can do independently) and, finally, mastery (can teach others). How many science teachers are focused on planning for explicit differentiation in spreadsheet skills when there are other competing areas that may be more important to differentiate for in order to ensure successful learning?

DISCUSS: How would you differentiate for an EdTech tool in your classroom? What would be the challenges of doing so?

Reason 5: the post-digital misconception

In the era of the post-digital, many assumptions are made about the digital literacies of both teachers and students. However, we should always evaluate our assumptions as suggested by one science teacher when asked about the importance of teachers being digitally literate:

> *"Whether or not [teachers] can teach students to use [digital platforms] is important because the assumption that all students will naturally gravitate and be skilful at any given technological tool that's given to them is of course, false. You know they have some superficial aptitudes at particular digital experiences, because those have become more common. But that doesn't mean that they are proficient at using them for the purpose of that education."*

This assumption could be applied to teachers as well. Valverde-Berrocoso et al. (2021) found that many teachers believe that the advice they have been given regarding integrating technology in the classroom has been scarce and insufficient. Teachers reported that they did not feel that schools were evaluating their ICT competencies in sufficient depth or regularity. In an age where (almost) everyone has multiple devices and social media, educational institutions may have felt that teaching their staff and the students ICT skills and competencies was a redundant process. However, being able to stitch together a TikTok and conducting multi-step calculations in a spreadsheet are not the same skillset.

DISCUSS: What assumptions do you make about the digital literacies of your students? What might happen if your assumptions turn out to be flawed?

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